

Acta Tropica 64 (1997) 109–122



Principles of the surgical approach in human liver cystic echinococcosis

Roberto Perdomo*, Carmelo Alvarez, José Monti, Ciro Ferreira, Antonio Chiesa, Alberto Carbó, Ruben Alvez, Rosario Grauert, Dafna Stern, Carlos Carmona, Luis Yarzabal

Unidad de Biología Parasitaria, Instituto de Higiene, Alfredo Navarro 3051, C.P. 11600 Montevideo, Uruguay

Received 20 May 1996; revised 26 July 1996; accepted 14 September 1996

Abstract

Ultrasonography (USG) has recently contributed much to the diagnostic of hepatic cystic echinococcosis (CE). The use of portable ultrasonograph allowed us to perform a community survey among 9482 people living in a high risk area for CE in the Florida Department (Uruguay). Positive USG results were found in 123 asymptomatic patients. 48 out of 51 USG positive cases were surgically confirmed and 3 were found to be false positive. The results of this survey allowed us to propose a new classification of the echographic imaging based on the parasite's various evolutive and involutive stages. The *Echinococcus granulosus* cyst size was compared with the parasite's evolutive stages. The cyst's segmentary topography and the related risk of CE is evaluated. The importance of cystic-biliary communication is pointed out and its rational surgical treatment described. Finally, an algorithm is presented facilitating the choice of a rational treatment. © 1997 Elsevier Science B.V.

Keywords: Cystic echinococcosis; Liver; Community screening; Treatment algorithm; Imaging classification

* Corresponding author. Present address: Charrúa 2379, C.P. 11300 Montevideo, Uruguay. Tel.: + 598 2 780311; fax: + 598 2 796622.

PII S0001-706X(96)00641-9

1. Introduction

Since introduction of modern imaging technology, the previous firmly sustained statement that 'hydatid cyst always means surgical treatment' is no longer valid. Nowadays it is more correct to say that 'several *Echinococcus granulosus* cysts still need surgical treatment'.

The surgery in cystic echinococcosis (CE) is widening and at the same time it is becoming narrower. It is widening because of the increased number of asymptomatic carriers, discovered by chance and/or by mass screening in the risk areas. It is becoming narrower because indications for surgical treatment become limited after the introduction of chemotherapy and PAIR.

A new classification of ultrasonographic images based on the biological criteria has become a basis for the therapeutic choices. The USG characteristics, size and topography of *E. granulosus* cysts is to be analyzed before taking decisions about diagnosis and treatment of CE. In surgery, most of the CE cases have hepatic-biliary pathology, which involves biliary ducts of variable caliber. Problems to be solved by a surgeon, when the cyst contents are stained with bile, are discussed.

2. Patients and methods

2.1. Study design

The aim of the study is to develop an algorithm of the diagnostic and therapeutic guidelines, based on the results of echographic and serologic examination of CE cases detected by population screening. Three major parameters were taken into account:

(1) Evolutive stage of the parasite;
(2) Size of the cyst in relation to the evolutive stage;
(3) Risk related to the cyst's topography.

2.2. The patients

The survey was performed within the framework of a programme for controlling cystic echinococcosis in Uruguay, carried out jointly by the University of the Republic of Uruguay and the University of Cambridge, UK. A 'high CE risk area' in the Florida Department (Uruguay) was selected for the study covering the rural and urban population of Cerro Chato, Batlle y Ordonez, Fray Marcos, Casupá and Reboledo. From May 1993 to June 31, 1994, 9482 people there were screened by echographic and serological methods. The survey was done with the help of a group of surgeons, echographists, immunologists, veterinarians and medical and veterinary students.

The age of the people screened varied from 3 to 88 years. Although the census figures showed the male population in Florida to be slightly larger than the female population (51.5% versus 48.5%), fewer males than females participated in the study

(46.3% versus 53.7%). Depending on the area 69.9 to 84.7% of the population screened resided in towns.

2.3. Ultrasound examination technique

A portable lineal convex sector ultrasound scanner (Aloka Eco Camera model SSD-500) was used as the echographic equipment. Skilled echographists (Drs Alberto Carbó and Ruben Alvez) interpreted the results and registered them by video printer; some cases were also recorded on colour slides.

2.4. Ultrasound image classification

144 positive USG images were classified according to the various evolutive stages of *E. granulosus* metacestodes from their hepatic implantation and growth until their degeneration and death (Fig. 2). The classification was partly confirmed by an analysis of the viability of protoscolices in 65 cysts removed from 43 operated patients (Alvarez and Perdomo, 1994).

An early cystic stage image, placed to the left of the classification scheme (Fig. 2), can only move to the right side, towards a more advanced evolutive or involutive stages. Pericyst calcification was visible in various parasitic evolutive stages; it has a great diagnostic value but, as it is not part of the parasite itself, it cannot influence the classification of the parasite evolutive stages.

2.5. Measurement of cyst size

Together with the other imaging characteristics, the size of all cyst was measured by ultrasonography, taking into consideration their two largest diameters and calculating a mean size value in mm.

2.6. Segmentary topography classification

The classic classification of hepatic segments, proposed by Couinaud (1957) was used for cyst topographic evaluation. It is expressed in numbers starting from I to IV in the left liver lobe and from V to VIII in the right liver lobe. Fig. 4 shows distribution and frequency of *E. granulosus* hepatic cysts in 105 patients.

2.7. Serological techniques

For each CE positive echography case, an age and sex matched control case with negative echography was chosen and both CE positive and control negative cases were examined serologically by enzyme linked immunosorbent assay (ELISA), standardized in our laboratory, and a latex agglutination test (Coltorti et al., 1990). The latex agglutination test was carried out using a commercial kit (Latex Hidatidosis, Tex, Uruguay).

Total examined individuals	9482
Total positive results	123
Actual expected Q.H. Nr. *	120
Prevalence : $\frac{120}{9482}$ x 100	1.27 %

* Positive X V.P.P.P. : 123 X 0,98

Fig. 1. Prevalence of non-symptomatic hepatic cystic echinococcosis.

2.8. Confirmation of CE diagnosis by surgery

In 51 patients the echographic images were correlated with the parasitological findings in surgically removed cysts. Cyst contents were carefully microscopically examined for hooks, protoscoleces, germinative layer fragments and macroscopically for secondary daughter vesicles, bile staining of the cyst fluid and jelly-like and/or necrotic substances filling the cyst.

3. Results

3.1. Results of ultrasound screening

The transversal and prospective USG study of the abdominal cavity of 9482 people in the Florida Department found 123 individuals having cyst USG images compatible with hepatic CE. In total 144 cyst images were found; 98 cases had a single space occupying lesion, 20 cases had double lesions and 2 cases had three cysts. These figures represent a prevalence rate of 1.27% (Fig. 1).

Table 1
Age distribution of 8596 human cases echographically positive for cystic echinococcosis

Age groups in years	Total No. examined	No. positive	Prevalence
0–9	1515	5	0.33
10–19	1711	8	0.47
20–29	919	9	0.98
30–39	1152	18	1.56
40–49	1136	22	1.93
50–59	832	12	1.44
60–69	757	21	2.77
70–79	448	17	3.80
≥80	126	2	1.59

Positive cases occurred in persons of all age decades (Table 1). An age group analysis showed that there was a statistically significant increase of CE with age ($P = 0.005$). There was no significant difference in the frequency of CE between sexes ($P > 0.25$). The prevalence of CE among rural persons was significantly greater in comparison with the urban population ($P = 0.02$). The likelihood of an individual having an asymptomatic infection significantly increased in persons with a previous history of CE ($P < 0.001$).

3.2. Results of serological examination

Two serologic techniques were compared: a latex particle agglutination test and an ELISA assay in 68 patients with positive echographic diagnosis, including 35 males and 33 females and ages ranging from 5 to 82 years. The diagnosis was confirmed in all 48 of these patients, who underwent surgery (Table 2). In the groups representing various types of hydatid cysts ELISA examination was positive in ranges 47–100% and the latex particle agglutination test was positive in ranges 24–60%. Observed variability confirm the importance of determining the evolutive stage by echography when analysing serology results. It is evident that the higher diagnostic value of ELISA and its technological simplicity predisposes that assay for use in a mass serological survey.

3.3. Surgical confirmation of CE diagnostic

51 patients with positive echography underwent surgical treatment and CE was confirmed in 48 patients. 3 cases were false positive: 1 had a gastric leiomiosarcoma, 1 had kidney cancer, and 1 has a hepatic simple serous cyst.

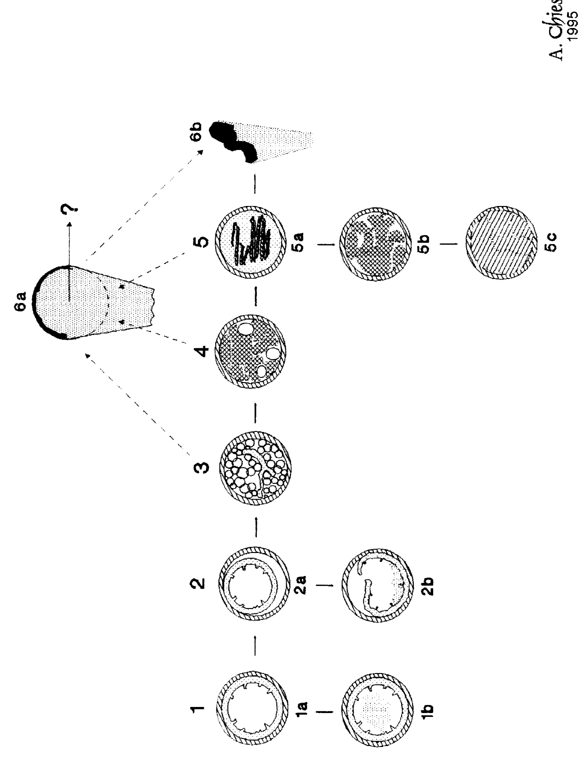
3.4. Classification of the cyst's image and size

The observed *E. granulosus* cysts were classified into two major groups (Fig. 2): those with an evolutive character (T1 and T3) and those with a definite involutive character (T4, T5 and T6); stages classified as T2 may be short transitory phases to stage T3 or involutive phases towards T5 or T6.

A relationship between the size of 118 cysts and their different evolutive stages is presented by a dispersogram in Fig. 3. The range of the mean diameter of the cyst size was between 10 and 170 mm; 10 mm was accepted as the limit of echographic visibility.

The predominating size of the cysts (88.3%) was below 75 mm. Within that size limit, there were more cysts (64.2%) with definite involutive lesions (T5a, T5b and T5c) than with the evolutive lesions (35.8%) classified as T1–T4.

In the sector of evolutive lesions (T1–T4) the hyaline cysts, with clear fluid (T1 and T2), were more numerous (62.5%) than multi and pauci-vesicular cysts (T3 and T 4) (37.5%). Subgroups T2a and T2b were visible in very few individuals; this suggests that these stages are of brief duration, probably as transitory stages to further stages. Calcified lesions were found in all groups below 40 mm of diameter.



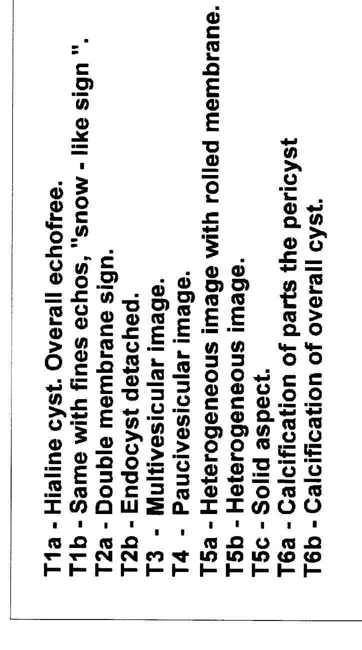


Fig. 2. Biological evolutive stages of the hepatic echinococcus cyst.

Table 2
Sensitivity of different techniques in relation to the biological stage of the parasite in 68 patients

Type of hydatic cyst	Ultrasound positive diagnosis (%)	Latex agglutination positive diagnosis (%)	Elisa positive diagnosis (%)		
			wh-Ag total IgG	pI-Ag IgG1	pI-Ag IgG4
T_{1ab}–T_{2ab}	100	45	82	80	70
T_3	100	60	90	80	100
T_4	100	50	100	100	100
T_{5abc}	100	24	47	38	35
T_6	100	50	100	33	33

wh-Ag, anti-whole fertile cyst fluid antigen; pI-Ag, anti-periodate treated antigen.

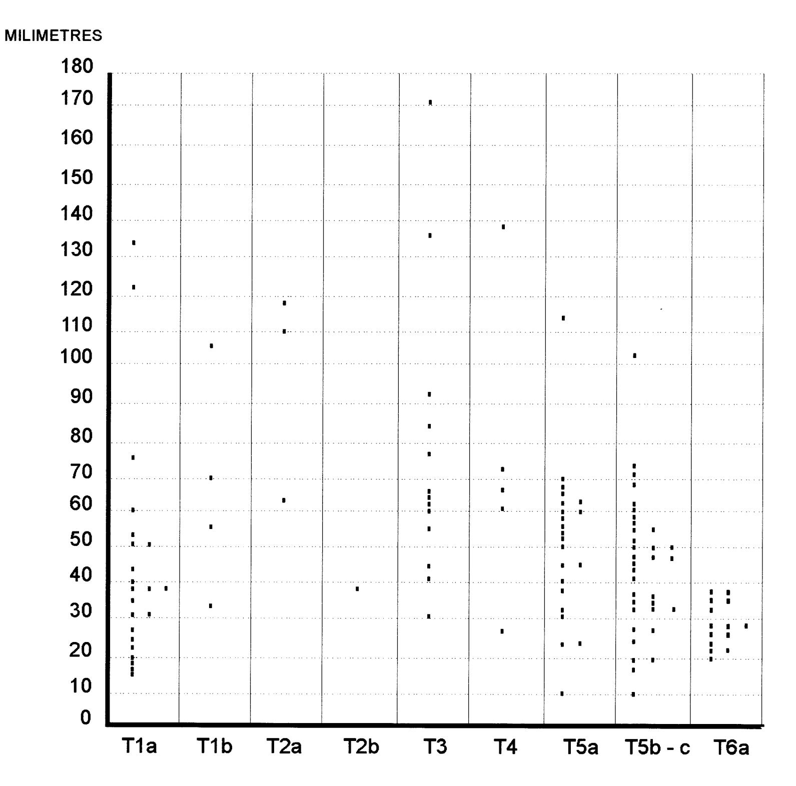


Fig. 3. Cyst size (in mm) related to the evolution stages.

In the group above 75 mm of diameter, cysts with viable protoscolices clearly prevailed. However, one should consider the fact that some hyaline cysts (T1) of less than 50 mm in diameter also had viable protoscolices (the smallest such cyst had 20 mm of diameter). Inside the secondary daughter vesicles below 5 mm in diameter, present in multi and pauci-vesicular cysts, viable protoscolices were rarely found (Alvarez and Perdomo, 1994).

3.5. Segmentary topography of the hepatic cysts

Segmentary topography of the hepatic cysts shows proportions of the cysts located in various liver segments (Fig. 4) and their corresponding risks (Fig. 5). The cysts located in VII and VIII segments of the right liver lobe clearly (46%) outnumber the others. Such location creates a double risk: (i) the proximity of the diaphragm occasionally requires a transthoracic surgical approach and a threat of hepato-thoracic communication risk; (ii) caval-suprahepatic venous system lesions may occur (Fig. 5).

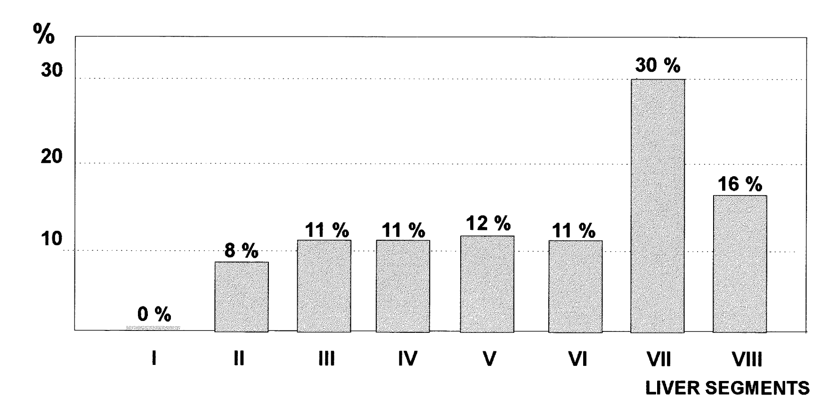


Fig. 4. Frequency of hepatic cysts according to segmentary distribution in 105 patients.

3.6. The biliary communication with E. granulosus cyst

Another important factor related to topography is the relation of cysts to the biliary system, which frequently causes a problem. The cyst topography that is most likely to cause a serious lesion of the biliary tract and the hilum is within segment IV (Fig. 5). However, cysts in any other position, when they reach a certain size, may also develop cystic-biliary communication (Fig. 5). Bile is a common component of the hydatid cyst cavity, affecting vitality of the germinative layer and damaging protoscolices; Alvarez and Perdomo (1994) found bile in 17 out of 41 (41%) cysts examined.

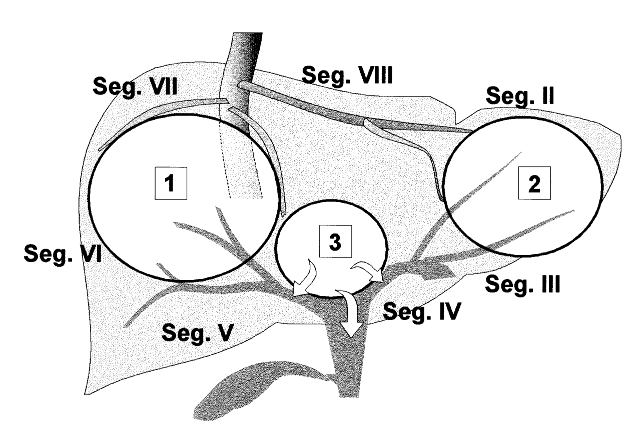


Fig. 5. Vascular (1–2) and biliary (3) risk according to cystic segmentary topography.

4. Discussion

4.1. General comments

In 1970 Purriel et al. (1970) analysing the results of his postmortem studies stated that: "We have affirmed for more than two decades that it is necessary to interpret the hydatidosis pathology by means of the biological balance of the lesion…", and added that "the clinic, immune system condition and prognosis are very different if the host is a carrier of a healthy, sick or recently died hydatid, or one that has undergone degenerative processes".

This idea was further developed by Lewell and McCorkell, 1985; Caremani et al., 1991 and Alvarez and Perdomo, 1994. Now we are presenting an algorithm (Fig. 6) based on echographic classification of the parasite evolutive stages, the size and topography of *E. granulosus* liver cysts complemented by serology. The algorithm was designed to help in assessing the probability of CE diagnosis (positive - QH, uncertain - no QH), the risk of CE complications (risky and not risky) and the rational treatment approach (surgery, chemotherapy, 'watch and see') (Fig. 6).

4.2. Differential diagnosis of CE

It is essential to differentiate the active lesions with an evolutive capacity from involutive or degenerative lesions, and from arc-shaped lesions showing calcification. The evolutive stages of the last ones cannot be echographically determined due to their calcified shell and require a CT examination to find out whether there are daughter cysts inside or not.

The hyaline cyst, with pure liquid contents (T1a), may cause serious differential diagnostic problems with a simple serous cyst. Positive serology suggest CE but when serology is negative, the diagnostic is uncertain, because of false negative serological results. The cysts known as pauci-vesicular cysts (T4) contain mainly an amorphous or degenerative substance (according to the echography) with rather scarce daughter cysts inside. They usually disappear quickly but need to be differentiated from other solid lesions (e.g. neoplasm). This involutive stage may not need surgical treatment but only chemotherapy or observation, depending on topography of the lesions.

Heterogeneous or solid lesions (T5a, T5b and T5c) also generate problems of differential diagnosis with primitive or secondary non-malignant and malignant tumours. Serology may be of some help, if positive. In cases of negative serology a fine needle biopsy can be carried out with small risk in these cases; a biopsy has already clarified the origin of the lesions in 7 of our patients?

4.3. Algorithm facilitating the choice of treatment

The algorithm (Fig. 6) allows us to choose, step by step, the rational procedure, leaving aside the previous concept that 'hydatid cyst always means surgical treatment'. The role of surgery is still important, but now there are also other options,

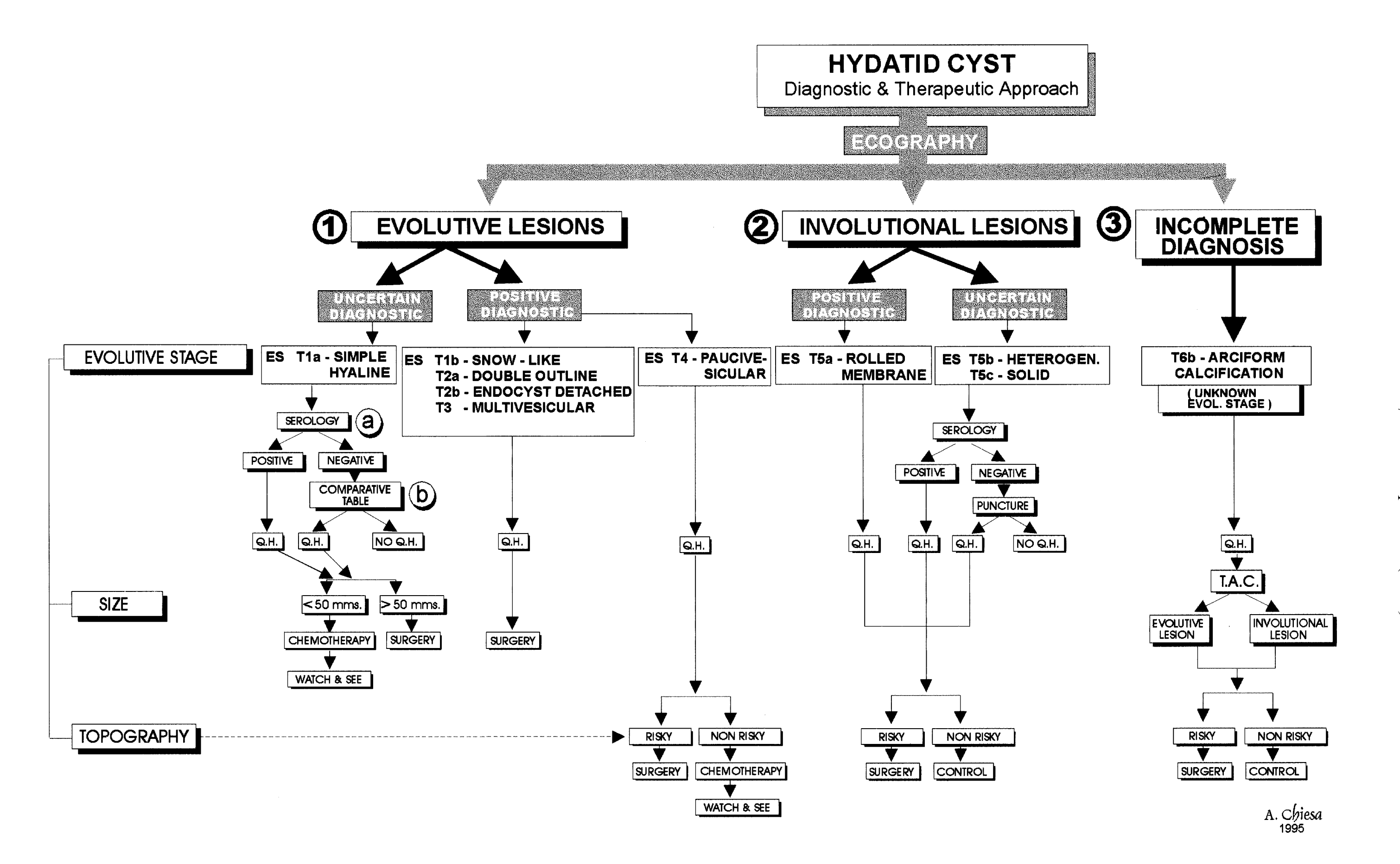


Fig. 6. (a) ELISA & latex tests, (b) for a useful comparative table see Perdomo et al.: Differential diagnosis between hyaline anechoic liver echinococcosis cyst and non-echinococcosis cyst. XVII Int. Congr. Hidatidology, Limassol, 1995. Abstracts.

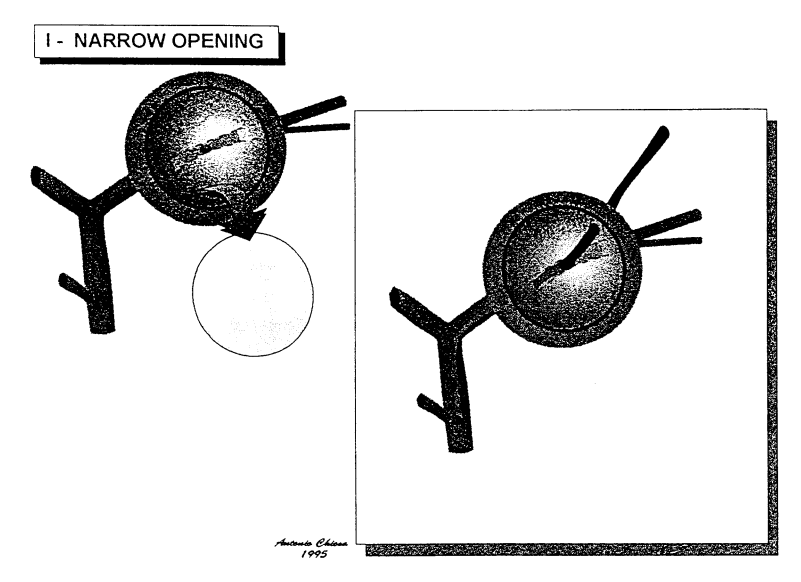


Fig. 7. Direct tubing with probe of adequate guage.

such as simple observation, with a periodic echographic follow-up ('watch and see'), delayed surgical treatment and chemotherapy as supporting or basic treatment.

PAIR is not referred to because time will confirm its effectiveness and risks (Bret et al., 1988; Filice et al., 1991). In PAIR technique, the risk of an immediate anaphylactic reaction is minimized, but it is still necessary to evaluate the long-term risk of a secondary peritoneal or pleural *E. granulosus* infection.

4.4. The major risk of surgical treatment

The major risks of modern surgical treatment of hydatid cyst are as follows:

(i) Location of the lesions in the caval-suprahepatic venous arbor area makes any attempt to pericyst resection unsafe.

(ii) Biliary communication left behind; this should be always repaired in the first instance by means of intubation and/or disconnection (Perdomo et al., 1984; Settaf et al., 1989; Moreno González et al., 1994). If the surgeon is not aware of a bile communication and does not act properly, a more or less long and intense bilirrhage will develop in the postoperative stage requiring cystic drainage for a longer time. Such drains can also favour a residual cavity infection. The complication is serious if cystic-biliary communication takes place at the hepatic hilium level. This problem can be solved by intubation of the communicated biliary duct, according to the schemes in Figs. 7 and 8, one showing a small opening and the other a wide opening. This procedure is known as the cystic-biliary disconnection technique (Perdomo et al., 1984). It is based on separation of the tubes by an inflammatory reaction similar to the way that any strange object introduced in a living tissue becomes separated.

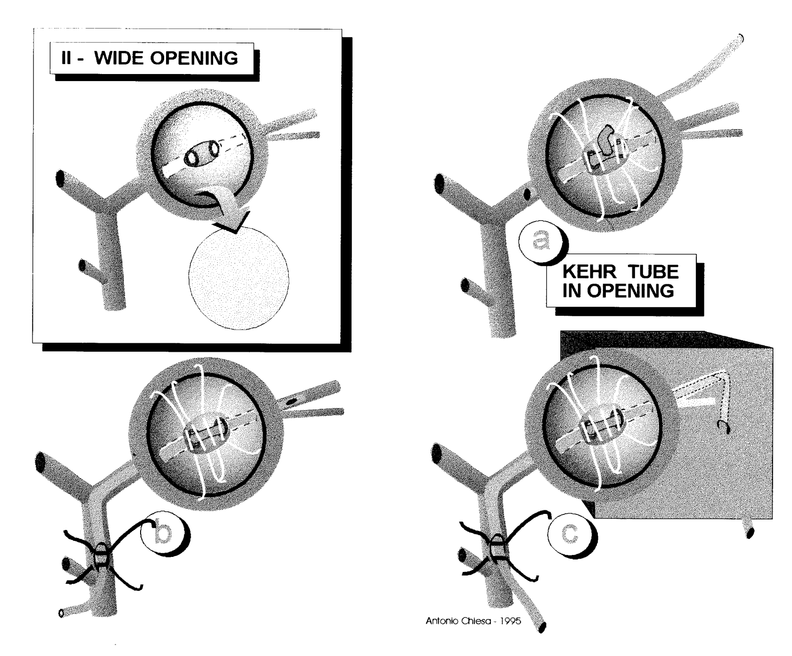


Fig. 8. (a) KEHR tube in the opening, (b) probe sent up through the choledochotomy, (c) Seton probe sent up from the choledochotomy.

(iii) Size is also an important risk factor: the bigger the size the more possibilities of complications exist. According to the dispersogram (Fig. 3), the highest size of asymptomatic well-tolerated lesions would be less than 75 mm, however, the safety limit is smaller and surgical treatment is advised at cyst size above 50 mm. Below such a limit, the cyst (if it is deep, especially in the right lobe) will probably not contact the hepatic surface and a transhepatic surgical procedure may be necessary. In such a case chemotherapy may be a preferable treatment, followed by watching the evolution of the *E. granulosus* cyst.

References

Alvarez Gabrielli, C. and Perdomo, R. (1994) Implicancia terapéutica de la fertilidad del quiste hidático en los distintos estados evolutivos de la hidatidosis humana. Cir. Uruguay 64, 231–234

Bret, P.M., Bretagnolle, M., Valette, P.J., Thiesse, P., Lambert, R. and Labadie, M. (1988) Percutaneous aspiration and drainage of hydatid cysts in the liver. Radiology 168, 617–620.

Caremani, M., Vicenti, A., Benci, A., Maestrini, R. and Rossi, G. (1991) The sonography differential diagnosis of cystic hydatid disease. John Libbey CIC, Rome, Italy, pp. 521–529.

Coltorti, R.A., Fernández, E., Marguet, E.R., Scozzina, J.D. and Guarnera, E.A. (1990) Detección de portadores asintomáticos de quistes hidáticos: aumento de la especificidad del ensayo inmuno-enzimático. Rev. Inst. Med. Trop. San Pablo 32, 275–284.

Couinaud, C. (1957) Le Foie, Masson Ed., Paris.

Filice, C., Stroselli, M., Brunetti, E., Colombo, P., Emini, E. and D'Andrea, F. (1991) PAIR (puncture, aspiration, introduction, reaspiration) with alcohol under US guidance of hydatid liver cysts. John Libbey CIC, Rome, Italy, pp. 811–817.

Lewell, D.B. and McCorkell, S.A. (1985) Hepatic echinococcal cyst: sonographic appearance and classification. Radiology 155, 773–775.

Moreno González, E., Herrera Cabreras, V., González Pinto, I. and Hidalgo Pascual, M. (1994) La ruptura intrabiliar como complicación de la hidatidosis hepática. Rev. Argentina Cirug. 67, 65–69.

Perdomo, R., Geninnazzi, H., Santana, C. et al. (1984) Abertura lateral de conductos biliares principales en la adventicia hidática. Su tratamiento por desconexión quisto-biliar. Cir. Uruguay 54, 84–97.

Purriel, P., Mendoza, G. and Decedo, H. (1970) Hidatidosis en el Uruguay. Estudio epidemiológico (1962–1968). El Tórax 9, 1–15.

Settaf, A., Lahlou, M., Oudghiri, D., Aghzadi, R. and Belmani, D. (1989) Kystes hydatiques du foie ouverts dans les voies biliaires. Traitement par desconection kysto-biliaire. Presse Med. 18, 1475–1478.